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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/697,438	10/31/2003	Kei Watanabe	04329.3168	7758

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EXAMINER

MAI, ANH D

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 05/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

4A

Office Action Summary	Application No. 10/697,438	Applicant(s) WATANABE ET AL.	
	Examiner Anh D. Mai	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 April 2005.
 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
 4a) Of the above claim(s) 13-27 is/are withdrawn from consideration.
 5) ☐ Claim(s) _____ is/are allowed.
 6) ☒ Claim(s) 1-3 and 6-12 is/are rejected.
 7) ☒ Claim(s) 4 and 5 is/are objected to.
 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
 10) ☒ The drawing(s) filed on 31 October 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>10/31/2003</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Group I, claims 1-12 in the reply filed on April 13, 2005 is acknowledged.
2. Claims 13-27 have been withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on April 13, 2005.

Specification

3. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested:

SEMICONDUCTOR DEVICE HAVING A LOW-DIELECTRIC CONSTANT
LAYER FORMED ON A LOW-DIELECTRIC CONSTANT BUFFER LAYER.

Claim Objections

4. Claim 12 is objected to because of the following informalities:

It appears that claim 12 tries to add another level of the metal wiring on the existing structure. If that is the intention, then claim 12 should recite:

“A semiconductor device according to claim 1, further comprising an upper metal wiring layer which is connected to the metal wiring through another low-dielectric constant film, another buffer layer and another anti-meal diffusion film.”.

Appropriate correction is required.

Drawings

5. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the “other level of the interconnect” (as recites in claim 12) must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claims 1-3, 6, 10 and 11 are rejected under 35 U.S.C. 102(e) as being anticipated by Yuasa et al. (U.S. Pub No. 2004/0089924).

Yuasa teaches a semiconductor device as claimed including:

a metal wiring (104) provided on a semiconductor substrate (100);

an anti-metal diffusion film (105) formed on the metal wiring (104);

a buffer layer (106b) which formed on the anti-metal diffusion film (105) and includes at least a silicon-methyl radical bond and a silicon-oxygen bond; and

a low-dielectric constant layer (106) which is formed on the buffer layer (106b) and includes at least the silicon-methyl radical bond and the silicon-oxygen bond,

wherein the silicon-methyl radical bonding density of the buffer layer (106b) is less than the silicon-methyl radical bonding density of the low-dielectric constant layer (106). (See Fig. 1).

Regarding the silicon-methyl radical bond of the buffer layer (106b) and the low-dielectric constant layer (106), since both layers are formed by methyl-containing precursor (e.g. DMDEOS), thus, the resulting layer inherently contains silicon-methyl radical bond and a silicon-oxygen bond.

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Density of the buffer layer (106b) is higher than that of the low-dielectric constant layer (106), hence the silicon-methyl radical bonding density of the buffer layer (106b) is less than that of the low-dielectric constant layer (106).

With respect to claim 2, the buffer layer (106b) of Yuasa has a thickness of 10nm, hence not more than 30nm.

With respect to claim 3, the low-dielectric constant layer (106) of Yuasa has a specific dielectric constant of 2.8, hence not more than 3.1.

With respect to claim 6, metal wiring (104) of Yuasa is a copper wiring, and the copper wiring (104) is embedded in a surface portion of an insulating layer (101) provided on the semiconductor substrate (100) having an element devices formed thereto.

With respect to claims 10 and 11, the buffer layer (106b) and the low-dielectric constant layer (106) of Yuasa is a first and second methyl radical-containing silicon oxide film formed by using an organic silicon compound containing a methyl radical as a raw material.

Product by process limitation:

The expression “formed by using an organic silicon compound containing a methyl radical as a raw material” (as recited in claims 10 and 11) is/are taken to be a product by process limitation and is given no patentable weight. A product by process claim directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); *In re Brown*, 459 F.2d 531, 535, 173

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USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product “gleaned” from the process steps, which must be determined in a “product by process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

Note that Applicant has burden of proof in such cases as the above case law makes clear.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yuasa ‘924.

As best understood by the examiner, Yuasa is shown to teach all the features as describes in claim 1 above, with the exception of explicitly disclosing the next level of the interconnect.

However, it would have been obvious to one having ordinary skill in the art at the time of invention to form multiple levels of the interconnect on the metal wiring of

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Yuasa, since it has been held that mere duplication of the essential working parts of a device involves only routine skill in the art. *St. Regis Paper Co. v Bemis Co.*, 193 USPQ 8.

8. Claims 7-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yuasa '924 as applied to claim 1 above, and further in view of Bao et al. (U.S. Patent No. 6,455,417) of record.

With respect to claims 7 and 8, Yuasa teaches a semiconductor device as described in claim 1 above, thus, Yuasa is shown to teach all the features of the claim with the exception of the utilizing methyl radical-containing silicon nitride or silicon carbide materials for the anti-metal diffusion film.

However, Bao teaches an anti-metal diffusion film (14') is formed using organosilane (e.g. tetramethylsilane) carbon and a nitrogen source, hence SiCN.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the anti-metal diffusion film of Yuasa using the material as taught by Bao since both materials of Yuasa and Bao are well known barrier materials, thus can be used interchangeable.

With respect to claim 9, the anti-metal diffusion film (14') of Bao is a laminated film of a methyl radical-containing silicon nitride film and a methyl radical-containing silicon carbide film.

Allowable Subject Matter

9. Claims 4 and 5 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. The following is a statement of reasons for the indication of allowable subject matter: the prior art of record fails to fully disclose either: a silicon-methyl radical bonding density relative to a silicon-oxygen bond in the buffer layer is not less than 22% (as recites in claim 4) nor a silicon-methyl radical bonding density relative to a silicon-oxygen bond in the low-dielectric constant film layer is not less than 25% (as recites in claim 5).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (571) 272-1710. The examiner can normally be reached on 9:00AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you

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have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Anh D. Mai', with a long horizontal flourish extending to the right.

**ANH D. MAI
PRIMARY EXAMINER**

April 28, 2005